Physician use of computers: Is age or value the predominant factor?

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Abstract: One common explanation for the failure to achieve broad physician utilization of computer applications has been the suggestion that "We can't teach older individuals to use computers." To investigate this hypothesis, we examined utilization patterns for the Clinical Information System (CIS) at Columbia Presbyterian Medical Center (CPMC). We analyzed CIS usage for 925 attending physicians who were listed as an admitting or attending physician or surgeon for at least one patient during the year 1992. Sixty-one percent (561/925) of the attending physicians used the system at least once during the year. Sixty five percent (186/287) of the physicians who admitted at least 50 cases used the system at least 120 times during the year. The most surprising aspect of our analysis was that physicians in their late 60's and early seventies actually used the system more than their peers who were in their late 50's. Patterns of use by age group were similar for those who admitted many and few patients to the hospital. Using linear regression and chi squared analysis, we found that age is correlated ($p < 0.002$) with levels of physician use (inquiries per case), although age can explain (r-squared) only 3% of the observed variation in utilization patterns. We also found that there was significant variation in utilization (inquiries per case) by attendings in different departments ($p < 0.007$). However, the variation within departments was also large. We conclude that age and type of practice are statistically significant but not major factors in predicting which attendings will use the system. Growth rates over time (19% year to year increase in the average number of different users per day) indicate that, if present trends continue, virtually all physicians regardless of age will use the Clinical Information System for results review. We continue to feel that providing value, access and ease of use are the most important determinants for success.

INTRODUCTION

Over the last three decades, many individuals have been involved in building computer applications for medicine. One notable lack of success during this time has been the inability to encourage large numbers of physicians to use computers as part of their daily routine [1,2]. There have been several explanations suggested for this lack of physician involvement. The first postulated reason is the amount of time required to use the applications. Tierney and co-workers [3] have indicated that many computer-based applications take longer to use than traditional methods which are based upon paper charts. A second possible reason is the amount of value derived from the application by the physician. Friedman and Gustafson [4] have observed that many of the computer based applications do no more than emulate pieces of paper. A third speculation has been somewhat more controversial. People have suggested that physicians who have grown up without using computers as part of their daily life may be more reticent to use them in the practice of medicine than those who have been educated using computers. Those who disagree with this thesis point out that the use of word processing applications does not appear to be affected by age related factors. Erica Drazen [5], while discussing the shortcomings of one particular system has been quoted as saying "older doctors did not appear 'turned off' by new technology. 'I think that the age difference (factor) is a myth. I think that the old guys are wiser than the young guys and didn't use the system because it didn't work.'"

METHODS

To investigate whether age correlates with levels of physician utilization of computer applications, we examined the use of the Columbia-Presbyterian Clinical Information System. In January of 1990, after 2 1/2 years of development, the CIS was introduced [6] as part of the overall IAIMS effort at CPMC. The primary focus of the CIS was to provide results review to physicians. To use the system an individual enters an ID and a password. The second screen asks for patient identification and viewing option. The third screen lists the most recent date for different types of results and allows selections of the desired results. One can access clinical laboratory, pathology, radiology,

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cardiology, and neurology test results, transcriptions of discharge summaries, admitting notes and operative reports, demographic data (including insurance information), and a coded history of all the patient's encounters at CPMC on an in- and out-patient basis. Pharmacy data for inpatients is currently being added to this list.

For confidentiality and security reasons, we keep a log of every inquiry (user, patient, type of data retrieved). To analyze whether age was a significant factor in utilization, we examined these files for the entire year of 1992. We determined which attending physicians had been registered as active providers for one of 53,062 cases during 1992. Being an active provider means that the physician was listed as an admitting, or attending physician or surgeon for an in-patient. These criteria eliminated radiologists and pathologists as well as some physicians who did not actively provide patient care during the year. We further classified each active physician by year of birth and academic department. We determined the amount of inquiries made by each active physician and the number of inquires divided by the number of cases in which that physician was involved. The resulting Inquiry per Case Quotient (ICQ) provided a normalizing factor to remove the effect of varying case loads among physicians. We then stratified the physician by age and performed a chi squared test to test the null hypothesis that the amount of use is independent of the age of the physician. We performed a linear regression test for the ICQ vs age. We also used a one way, non-parametric analysis of variance to test whether there were significant differences in utilization which depended upon the type of service the physician performed.

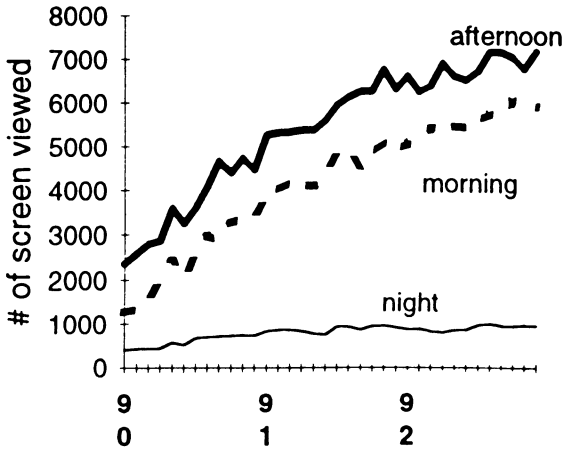

Figure 1. CIS utilization: 1/90 - 12/92

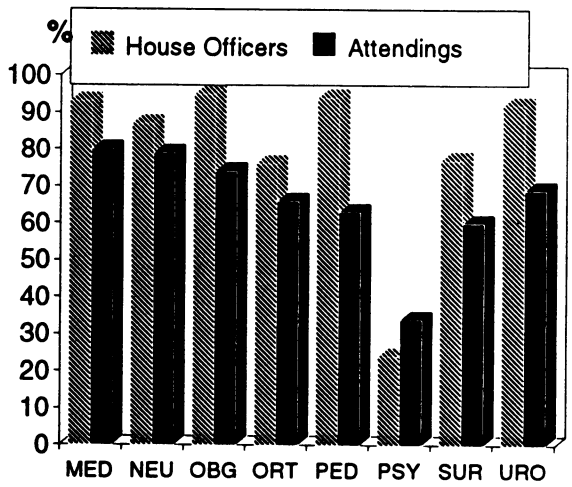

Figure 2. Use by attendings and residents: Dec. 1992.

RESULTS

We will discuss the overall utilization of the system, the degree to which age correlates with utilization and the differences in utilization between different medical services.

Overall levels of utilization

In 1992, there were 1535 attending physicians on the attending staff at CPMC. We found that 925 of these physicians were listed as a provider for at least one patient who was admitted to the hospital. Figure 1 shows the rate of growth in overall utilization of the system by plotting the number of screens viewed per hour each month since the system was installed. During 1992, the average number of different individual daily users (residents, nurses, students, technicians and attendings) rose by 19% to 1001. There were 2818 different individuals who used the system at least once during the month of December 1992. The average number of logons rose by 12% and the number of inquiries rose by 13% per year. Year to year comparisons show that much of this growth was due to increasing use by attending physicians. During 1992 sixty-one percent (561/925) of these physicians used the system at least once by entering their officially assigned logon ID and password. When we looked at only those physicians who admitted at least 50 patients to the hospital, then we found that 84% (240/287) used the system at least once during the year. To examine the amount of routine usage by busy physicians, we found that 186 (64%) of the 287 attending physicians with at least 50 cases made more than 120 inquiries per year. Figure 2 shows,

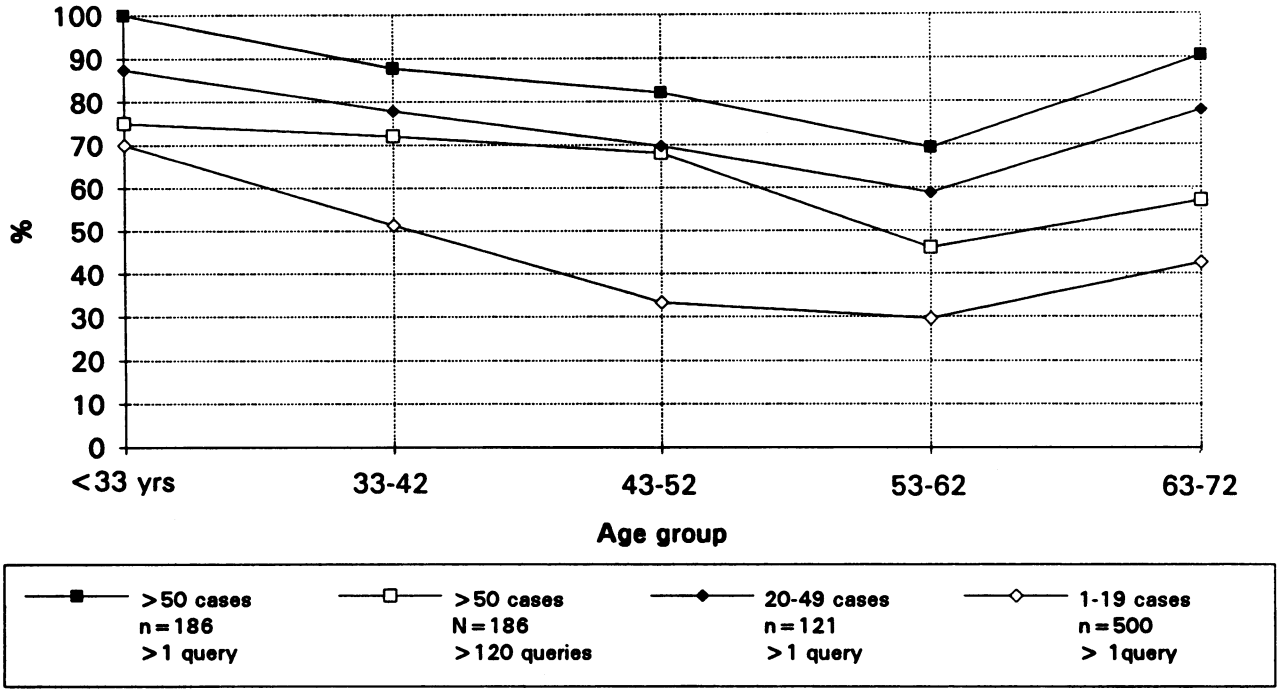

Figure 3. Use versus age

by department, the percentage of active attendings as well as residents who used the system during the month of December 1992. It is of interest to note that much of psychiatric care occurs in the New York State Psychiatric Institute (a state owned building in which the CIS is not yet available).

Correlation between age and utilization

For physicians grouped according to number of cases, Figure 3 shows by age, a plot of the percentage of attendings who used the system. For 287 physicians who had at least 50 cases during the year, 100% (12/12) of those between the ages of 29 and 32 used the system at least once. For those between 33 and 42 years of age 108 of 123 (88%) used the system. Between 43 and 52 years of age the utilization level drops to 82% (64/78), and drops further to 69% (36/52) for those between 53 and 62 years of age. However, for those between 63 and 72 the utilization level climbs to 91% (19/21), the second highest score for any decade. This pattern in which the lowest use occurs in the decade between 53 and 62 years of age repeats for all categories of usage thresholds and numbers of admitted patients. Chi squared and Mantel-Haensel tests for various physician age groups all showed that there was less than 0.01% ($p < .0001$) probability that the level of utilization was independent of age. Linear regression analysis of age vs inquiry count per case is shown in Figure 4. These data show that utilization does vary significantly ($p < 0.002$) with age. However the coefficient of determination (r squared) which measures the ratio of explained variation to total observed variation was only 3%. Thus, we find that while age is a significant factor, it explains only a small amount of the variation in utilization patterns of physicians.

Variation in utilization by medical specialty

When we looked at variability between departments using a one-way, non-parametric analysis of variance on the inquiry per case quotient (ICQ) we found significant differences between departments at the $p < 0.0001$ level. For each department, table 1 shows the mean number inquiries per case count (ICQ) per physician, the standard deviation about the mean, and the number of physicians in the department.

Table 1. Variation in utilization by department

Department	ICQ	Physicians
Medicine	14.67+-17.6	92
Neurology	7.12+-7.2	21
Pediatrics	3.52+-8.6	29
Urology	2.83+-3.7	14
Surgery	3.34+-4.0	34
OB/gyn	1.18+-2.7	52
Otolaryngol	0.76+-0.9	7
Ortho Surg	0.98+-1.4	16
Neuro Surg	1.07+-1.7	11

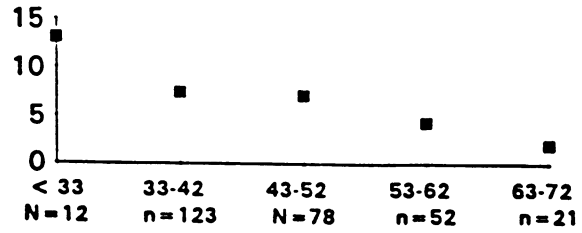

Figure 4. Inquiries per case by age for physicians with < 50 cases.

There is a factor of 10 difference in utilization between the departments that use the system the most and the least. However, by looking at the standard deviations of the inquiries per case within departments one sees that there are still very large variations in utilization within each department. Even when we normalized for variations in length of stay by department (3.5 days in Ob/Gyn vs 13.3 days for Medicine), there was an order of magnitude difference.

DISCUSSION

We limited our analysis to attendings because they have a broad age range and because residents must use the system in order to complete their assigned work. On the other hand, attending physicians can ask nurses, residents or secretaries to get data for them and thus, can choose whether to use the system. We conclude that although the medical specialty and the age of the physician are significantly related to levels of utilization, these two factors do not account for the majority of variation.

Of note is the fact that our screens are character based emulation screens which are not yet in conformity with emerging standards for graphical interfaces. We do feel that graphical user interfaces are easier to use, but our experience reinforces our belief that it is the content not the format which will entice people to use it. We know from our experience that any system must be self explanatory as people attempt to use it. We installed the system knowing that we would never be able personally train all of the users. We initially visited the nursing stations, talked to the residents, nurses, and physicians, and left 3" x 5" cards with printed instructions. This effort succeeded in raising consciousness and getting a core of knowledgeable users. The system was fully utilized by the residents within the first year, and we now give them a 15 minute overview of the system along with written instructions during their orientation week. More and more attending physicians began to use it as peers, residents, and nurses explained the capabilities and as we have added more than just laboratory and radiology results to the system. Some physicians have computer terminals workstations in their private offices so they are able to use the system much more than other physicians. We see increased number of physicians paying to be attached to the CPMC network.

The results of our study indicate that when needed information is obtainable (i.e. value is provided), people will use the system. At CPMC, we attacked the value issue by concentrating on providing benefit (results review) before we began to ask physicians to enter data into the computer. The resultant setting was a computer system in which the physician could get information that might not otherwise be available. The physician was not required to use the system. We kept the response time per screen flip under one second and made the system self learning by simplifying the navigation through the screen selections. We also put the data in reverse chronological order and put dates of the latest results on the early selection screens so that people would not look for data that weren't available.

We have not yet asked physicians to enter any data although at their request we have built a clinical profile application which allows them to enter problem lists, allergies and medications for outpatients [8]. A small but growing number of physicians use this application. Because we have not yet asked physicians to enter data, we are able to directly test the basic hypothesis that age is correlated with physician utilization. We assume that utilization patterns might change significantly when people are asked to enter data rather than just review data that might be difficult to find otherwise. Several of the other institutions that have written about difficulties in getting physician participation were concentrating mainly on physician order entry [2,3,7], which is, according to Tierney and co-workers, a question of time, not reticence to use a computer.

In conclusion, age and type of service are significant but minor predictors of physician attending utilization. It remains to be determined what the important predictors of utilization are. We feel that

as developers pay more attention to providing value to physicians, utilization will follow.

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